NOTES ON THE SPECIES OF *ERYTHRINA*. XII

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ABSTRACT

Based on an examination of 377 new collections, range extensions are noted for 24 species, *Erythrina sousae* Krukoff and *E. lanata* subsp. *calvesces* Krukoff are newly described, *E. megistophylla* is reinstated as a valid species, two forms (*E. petraea* and *E. oaxacana*) are raised to specific rank, and *E. crista-galli* var. *corallina* is reduced to synonymy. All new specimens from Nicaragua are cited, as well as selected African and Asian specimens. Vouchers are cited for specimens used in the chemical and pollination studies reported in this symposium.

Other papers in this series "Notes on the species of *Erythrina*" have been published as follows: Suppl. X (Krukoff, 1977b), Suppl. XI (Krukoff, 1978), Suppl. XIII (Krukoff, 1979a), Suppl. XIV (Krukoff, 1979b).

In connection with the preparation of this paper 377 new collections were examined. Of particular interest are the enormous new collections made in Mexico by the new head of National Herbarium, Mario Sousa, and his collaborators. Of 28 species and subspecies of *Erythrina* which occur in Mexico, only six (*E. petraea*, *E. montana*, *E. pudica*, *E. tuxtlana*, *E. tajumalcences*, and *E. berenices*) are not represented in this collection. Of particular interest are the new species, *E. sousae*, the first collection of *E. oliviae* outside of the type locality and the first collection since 1939 of *E. oaxacana*, which permitted the raising to specific rank of two forms (*E. breviflora* f. *petraea* and *E. breviflora* f. *oaxacana*).

Recent establishment of Río Palenque Science Center in the province of Los Ríos, Ecuador permitted me to receive for the first time fruits of *E. megistophylla*, which is very common in this region, resulting in its reinstatement as a valid species. It should be kept in mind that fruiting collections of *E. edulis* and its relatives are exceedingly rare, largely because of difficulties in preserving the easily spoiled, large, soft, and succulent seeds. *Erythrina megistophylla* seems to be confined to a narrow strip of low altitude wet forest along the western base of the Andes.

In connection with the project of the Flora of Nicaragua, now underway, I am citing in this paper all new collections from this poorly collected country. Vouchers for seeds under chemical studies by Prof. Jackson, specimens of *Erythrina* which were studied in relation to pollination, as well as collections of some selected African and Asian species which are of special interest, are also cited herein.

After 8 years of efforts we are now approaching the aim which we set before ourselves back in 1968 when I started extensive collections of *Erythrina* seeds in Central America. Between the Pacific Tropical Botanical Garden and Waimea Arboretum in Hawaii, we are growing around 70 species most of which were in flower in March 1979. I went there recently to lay the ground work for Dr.

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Herbert G. Baker (Berkeley) to study the constituents of their nectar in March 1980, and for genetic work which was initiated by Dr. W. L. Theobald in 1979. Incidentally, as a by-product of genetic studies we eventually hope to find some handsome hybrids resistant to drought, which would be very desirable for Hawaii, and some hybrids tolerant to frost, which would be desirable for cultivation in California. The living collection of *Erythrina* is in two compact, easily accessible areas, and as the trees are still young, their flowers can be reached by hand, an ideal condition for this type of work.

Erythrina Symposium IV is now being organized to be published late in 1980. It likely will include among others, papers on constituents of nectar of various species by Herbert G. Baker, on wood anatomy by Baretta-Kuiper (Utrecht), on erythrinas cultivated in California by Elizabeth McClintock, on minor alkaloids of erythrinas by A. H. Jackson, and the first paper on the genetics of the genus.

In the citation of specimens in this paper, those not followed by a herbarium acronym are deposited in the herbarium of the New York Botanical Garden (NY).

1. *Erythrina fusca* Loureiro, Fl. Cochinch. 427. 1790, based on *Gelala aquatica* Rumphius, Herb. Amb. 2: 235. *tab.* 78. 1750.

Nicaragua: *Avinoan Danin 76-22-2* (N of San Pedro); Matagalpa: roadside, ± 530 m, *W. D. Stevens 6033* (MO); Rivas: *W. D. Stevens 6624, 6639* (Isla de Ometepe), *William T. Gillis 10280* (F). Comores: Mayotte, *Tattersall 1* (K), *2* (K), *3* (K).

2. *Erythrina crista-galli* L., Mant. 99. 1767.

Erythrina crista-galli L. var. *corallina* N. Mattos, Loefgrenia 71: 3. 1977.

I have not seen the holotype of the variety [*J. Mattos 17372* (IPRN)] which is from a cultivated tree growing at Parque Farroupilha, Pôrto Alegre, Rio Grande do Sul. There is nothing in the description to suggest that it should be considered as a good variety.

Erythrina crista-galli has been widely cultivated from very early times, and is known at present in North America, and in many countries in South America, Africa, Asia, and Australia. As a consequence, there are many horticultural forms and hybrids.

Mexico: Distr. Fed.: Jard. del Pedrigal, cult., *H. Hernández 3* (Aug. 12, 1978).

3. *Erythrina falcata* Bentham in Mart., Fl. Bras. 15(1): 172. 1859.

Brazil: Mato Grosso: on road to Xavantina, *J. A. Ratter 2242* (UB).

This is the first record of this species from Mato Grosso.

4. *Erythrina dominguezii.* Hassler, Physis 6: 123. 1922.

Below is quoted a letter of Augusto G. Schulz, an eminent student of the Flora of Chacó, providing an elegant description of flowering and fruiting of this species:

Este hermoso árbol está actualmente (Mayo 20) con las ramas desnudas sin una hoja. Por setiembre–octubre se vestirá de gala con sus flores rosadas y ya pasada la floración vendrán las

hojas nuevas. Por diciembre, más o menos, estarán maduras las legumbres, con 2 a 4 semillas. Es una vaina ancha papirácea, que se abre sobre el árbol sin largar los granos; la llevara el viento pues es muy voladora. De modo que las semillas deben ser juntadas en el suelo, en las proximidades del árbol, según et viento.

The ranges of *E. dominguezii* and *E. verna* are partly in regions poorly accessible at the present time, and, at least in Mato Grosso and the Federal District in Brazil, their ranges seem to overlap. Furthermore, they are leafless when in flower and, as a result, many specimens are incomplete. It would be important to define more clearly their ranges of distribution. These two species can be distinguished in the field by color of the flowers: pink (rosadas) in *E. dominguezii* and red (rojas) in *E. verna*.

Argentina: Chacó: Colonia Benítez, *A. G. Schulz s.n.* (22/12-1978).

This is a voucher for the seeds which are under chemical studies by Prof. Jackson.

6. *Erythrina verna* Velloso, Fl. Flum. 304. 1825.

Brazil: Minas Gerais: *V. Gomes 2809A* (UB), *E. P. Heringer 2809B* (UB) (Fazenda São Clemente, cult.), *E. P. Heringer 7603* (UB) (Paraopeba); Distr. Fed.: Brasilia, *E. P. Heringer 16978* (RB) (na margem do cerrado).

Trees cultivated at Fazenda São Clemente have "white flowers." *Heringer 16978* is the first record of this species from the Federal District.

7. *Erythrina poeppigiana* (Walpers) O. F. Cook, U.S.D.A. Div. Bot. Bull. 25: 57. 1901.

Nicaragua: sierras de Managua (cult.), *David Neill 1075*. Brazil: Rondônia: Rio Pacaás Novos, *N. A. Rosa 887*, *W. Rodrigues 9645* (INPA).

This is the first record of this species from Rondônia.

8. *Erythrina suberosa* Roxburgh, Hort. Beng. 53. nomen 1814; Fl. Ind. 3: 253. 1832.

India: Bangalore: Pondichery, *G. Thanikaimoni 1301*.

This is a voucher for seeds which are under chemical studies by Prof. Jackson.

9. *Erythrina microcarpa* Koorders & Valeton, Booms. van Java 2: 61. 1895.

Java: *Herb. Bogor 9620* (BO), *12785* (flrs.) (L), *14598* (flrs. & young frts.) (L), *14599* (flrs.) (L), *Herb. Koorders. 46* (sterile) (L), *49* (sterile) (L), *51* (sterile) (L), *65* (flrs.) (L), *66* (frts.) (L), *71* (flrs.) (L), *72* (flrs.) (L), *coll. undesign. s.n.* (30/9-1931) (BO). Timor: *Herb. Bogor 50* (BO).

Outside the herbaria in Leiden and Bogor, this species is very poorly represented in collections and my recent search for it in various herbaria in the Orient and Europe was unsuccessful.

The species is confined to eastern Java and probably the neighboring Madura and Bali. I found a specimen of it from Timor among the unidentified specimens on the recent visit to the Bogor Herbarium.

10. *Erythrina stricta* Roxburgh, Hort. Beng. 53, nomen 1814; Fl. Ind. 3: 251. 1832.

India: *G. Ghose & Co. s.n.* (1978) (Darjeeling), *G. Thanikaimoni 1329* (Yercaud).

These two specimens are vouchers for seeds which are under chemical studies by Prof. Jackson.

11. *Erythrina resupinata* Roxburgh, Hort. Beng. 53. nomen 1814; Pl. Coromandel 3: 15, *pl. 220.* 1819.

The name of this species suggests that flowers are deflected from the rachis downward, as is the case with *E. folkersii*, *E. humeana*, and certain other species. It will be interesting to study pollination of it, which will be possible when our plants in the Waimea Arboretum, Hawaii come of age.

13. *Erythrina subumbrans* (Hasskarl) Merrill, Philipp. J. Sci. 5: 113. 1910.

India: *G. Thanikaimoni 1328* (Yercaud); Karnatak (=Mysore): Chickenalli, 900 m, *A. Meebold 9728* (Holotype of *E. mysorensis* Gamble) (CA).

Thanikaimoni's specimen is a voucher for seeds which are under chemical studies by Prof. Jackson.

14. *Erythrina breviflora* Alph. DeCandolle, Prodr. 2: 413. 1825.

I have treated (Krukoff, 1939) three perennial herbs, *E. leptorhiza*, *E. horrida* and *E. montana*, native to Mexico and closely related, as distinct species as they are well collected and understood. *Erythrina leptorhiza* is known from 109 collections from ten states, *E. montana* from 26 collections from five states, and *E. horrida* from 18 collections from the state of Oaxaca, and their ranges do not overlap. For their differences see the key in Krukoff & Barneby (1974: 363).

I (Krukoff, 1939) treated three small shrubs native to Mexico and closely related, as a single species, *E. breviflora* and two forms. Their ranges do not overlap but they are poorly collected, as related under *E. patraea* and *E. oaxacana*. I thought that the specimens were perhaps collected from the upper portions of plants and that the leaflets naturally were much smaller than those of the average collections of *E. breviflora*. The new collection by Mario Sousa of *E. oaxacana* is not only the first collection of the two entities since 1939, until now treated by me as forms, but provides the irrefutable evidence that the leaflets are normal and not confined merely to the upper portion of the plants. I now raise them to the rank of species. For their differences see Krukoff & Barneby (1974: 358).

14a. *Erythrina petraea* Brandegee, Zoe 5: 247. 1908.

Erythrina breviflora f. *petraea* (Brandegee) Krukoff, Brittonia 3: 255. 1939.

Mexico: Puebla: *C. A. Purpus 2680* (UC—holotype, DS).

For the reasons why I again have raised this entity to specific rank, see under

E. breviflora. It is still known only from five collections by C. A. Purpus from Cerro de la Yerba and one from Sierra de Mixteca, all in the state of Puebla and cited in my first monograph (Krukoff, 1939: 255).

14b. *Erythrina oaxacana* (Krukoff) Krukoff, comb. nov.

Erythrina breviflora Alph. DeCandolle f. *oaxacana* Krukoff, Brittonia 3: 256. 1939.

Mexico: Oaxaca: Mitla, ± 1833 m, *L. C. Smith 109* (US—holotype); Distr. Tlaculula, 8 km to the N of Díaz Ordaz (road to Guajimalaya), ± 2050 m, *Mario Sousa 7807.*

I have been waiting for a new collection of this entity since 1939; it was previously known only from three collections (including the type), all from high elevations in the state of Oaxaca.

Seeds of this species were collected for the first time (*Mario Sousa 7807*) and are described here: seed black, ±18 mm long, ±11 mm broad, hilum round, grayish ±2 mm in diam.

15. *Erythrina edulis* Triana in M. Micheli, J. Bot. (Morot) 6: 145. 1892.

Panama: Chiriquí: *K. E. Blum 2530A* (July 24, 1966—frts.) (SCZ), finca Collins, vicin. Boquete, cult.; *Grady Webster 16663* (June 21, 1971—flrs. scarlet), distr. Boquete, above Jaramillo, along N. slopes of Cerro Palo Alto, disturbed rain forest, ± 1333 m; *Laurence E. Skog 4062* (March 21, 1977—flrs.) (MO) coffee plantation near Boquete, ± 1400 m; *J. P. Folsom 2229* (flrs. orange red) (MO), cult. as a shade for coffee, *Barry Hammel 3017* (MO) (lower north slope of Barú, forest edge and pasture, 6000–6500 ft). Colombia: Cundinamarca: *H. García-Barriga 20059, 20062.* Ecuador: Napo-Pastaza: *H. Balslev Madsen 10324* (AAU) (Baeza, 2000–2200 m), *E. W. Davis 347* (S) (near Cosanga), Tungurahua: ± 1800 m (Aug. 13—frts.).

Specimens of E. edulis *seen by me in April 1979.*—In connection with the reinstatement of *E. megistophylla* as a valid species it is desirable to reexamine numerous (±200) specimens of *E. edulis* to ascertain which, if any, should be transferred to *E. megistophylla.* This I plan to do on my trips to various herbaria, but in the meantime I reexamined specimens which are deposited at NY, and they are cited below to facilitate the checking of other collections.

Venezuela: Táchira: *Steyermark 101274.*

Colombia: Antioquia: *Toro 834, 1082, Robledo s.n.* (*Kr. Herb. 15158*); Boyaca: *Lawrance 285, Ramos Nuñez s.n.* (*Kr. Herb. 15190*), *Pennell 8681*; Cauca: *Pennell & Killip 8047, 8288, Ramos Nuñez s.n.* (*Kr. Herb. 9413*); Cundinamarca: *Karsten s.n., Jaramillo s.n.* (*Kr. Herb. 9182*), *E. L. Little Jr. 7421, García-Barriga 12414, 17517, 20112, Al. Gentry 17129*; Huila: *Rusby 952.* (Total 17 collections.)

Peru: *Ocampo s.n.* (*Kr. Herb. 9530*); Amazonas: *Jef. D. Boeke 2084, Hutchinson 6831*; Cajamarca: *Woytkowski 6972*; Ayacucho: *Killip 22827*; Huánuco: *J. Schunke 8313*; Junín: *Killip 25840*; Pasco: *Woytkowski 7354.* (Total 8 collections.)

Ecuador: Azuay: *Camp E-537, E-2198, E-4403, MacBryde 446, 454*; Chimborazo: *Ira L. Wiggins 11061*; Loja: *Asplund 18033, Reinaldo Espinosa 668, 1347, Harling 6040, Hitchcock 21340, MacBryde 645, Penland 1152, Wiggins 10883*; Napo-Pastaza: *Jef. D. Boeke 378, C. H. Dodson 1960, MacBryde 848, 1493, P. J. M. Maas 3049* (U); Morona-Santiago: *Alberto T. Ortega U. 207*; Pichincha: *Asplund 16705*; Tungurahua: *MacBryde 665.* (Total 22 collections.)

Bolivia: La Paz: (?) *Buchtien s.n.* (*US 1097S32*).

Specimens of E. edulis *not seen by me in April 1979.*—From the card file of specimens of *E. edulis* seen by me since 1939, I compiled statistical data on specimens which were *not* seen by me in April 1979. Inasmuch as very few of

these, if any, are of *E. megistophylla*, these data give a fairly accurate distribution of *E. edulis*.

Colombia: Dept. undesign.—4 specimens; Antioquia—9; Caldas—1; Cauca—12; Cundinamarca—10; Huila—3; Magdalena—1; Norte de Santander—1; Putumayo—3; Tolima—4. Total—48 collections. Peru: Dept. undesign.—5; Amazonas—2; Ancash—2; Apurimac—2; Ayacucho—2; Cajamarca—2; Cuzco—6; Huánuco—3; Loreto—1; Pasco—1. Total—26 collections. Ecuador: Prov. undesign.—6; Azuay—1; Bolívar—2; Cañar—1; Chimborazo—6; Cotopaxi—2; El Oro—1; Esmeraldas—1; Imbabura—1; Loja—8; Los Ríos—2; Pichincha—5; Tungurahua—7. Total—44 collections.

Erythrina edulis *in Panama.*—In Suppl. VII I (Krukoff & Barneby, 1973: 110) cited the first collection of this species from Chiriquí, Panama, probably from a cultivated plant [*Croat 10629* (MO)]. In Suppl. VIII (Krukoff, 1976: 345) the second collection from a coffee plantation was cited [*M. Nee 10624* (MO)]. Five additional collections are cited in this paper. All of these collections are of *E. edulis* probably introduced to Chiriquí as a shade for coffee. *Webster 1663* has inflorescences borne on the old wood.

It would be important first to determine, presumably from finca Collins and/or other neighboring fincas, the source of their *E. edulis*, and secondly to procure seeds of the two forms, one with the more common type of inflorescence and the other with cauliflorous ones, for genetic studies in Hawaii.

Cauliflorous inflorescences are rarely found in species of *Erythrina*. They occur invariably in *E. megistophylla*, very seldom in *E. edulis*, and recently I received an excellent specimen of *E. schimpffii* [*Plowman 5457*, wrongly cited in Suppl. IX (Krukoff, 1977a) as "*3457*"] accompanied by excellent photos (presently filed at NY) which show inflorescences borne on the old wood.

Erythrina edulis is a medium size tree with orange flowers (standards), as is also the case with its close relative, *E. megistophylla*. It has a very extended distribution and thrives under more diversified altitudinal conditions than any other species of the genus. It has been cultivated extensively from times immemorial throughout the area to which it is native, and this must have added to its present complexity. The species is fairly uniform, by "*Erythrina* standards," in its vegetative and floral characters, both in the northern (Colombia) and in the southern (Peru) portions of its range, but is much more complex in Ecuador, which is also the home of *E. megistophylla*, *E. polychaeta*, and *E. schimpffii*, its only close relatives.

Unlike *E. megistophylla*, which is *usually* found at elevations below 300 m, *E. edulis* is *usually* found at elevations between 1,250 and 2,750 m. However, it occasionally occurs at much lower elevations, e.g., *Alberto T. Ortega U. 207* from the province of Morona-Santiago and *Acosta-Solis 13957* from Chimborazo are from an elevation of 300 m.

Below I will discuss very briefly some of the specimens which exhibit characters unusual for the species: *Killip 25840* (NY, US) (Junín, Peru) with inflorescences borne at the base of the trunk; *Camp E-4403* (Azuay, Ecuador) with inflorescences on the larger branches and trunk, in the manner of *E. megistophylla* and sometimes of *E. schimpffii*; *García-Barriga 12414* (COL) (Cundinamarca, Colombia) with small spines on the petioles and on the secondary veins on the upper surface of the leaflets, in this respect resembling *E. polychaeta*, and

Elbert L. Little Jr. 7421 (Cundinamarca, Colombia), *Schunke 8313* (Huánuco, Peru) and *Felix Woytkowski 7354* (Pasco, Peru) with small spines on the petioles.

As might be expected, the flowering season of this species varies considerably in different altitudes, localities, and regions.

For better understanding of the group, it will be necessary to introduce *E. edulis* and its relatives to Hawaii and study them genetically.

15a. *Erythrina* aff. *edulis* Triana

This *Erythrina* cannot be fully understood in the absence of fruits. It is characterized by a striking reticulation pattern of the leaflet blades, which is sharply elevated on the faces of the leaflets. For convenience, I am citing below all these specimens deposited with NY which I examined recently.

Ecuador: Chimborazo: 5.6 km W of Pallatanga, *MacBryde 694* (flrs.—Sept. 4, 1971); Cotopaxi: Pilalú, ± 2320 m, *MacBryde 561* (flrs.—July 7, 1971); Tungurahua: ± 1900 m, *Penland 101* (flrs.—March 16, 1939); Napo-Pastaza: *Harling 3921* (flrs.—Jan. 26, 1959), *B. MacBryde 860* (just W of Baeza, ± 1960 m) (flrs.—Oct. 26, 1971), *863* (1 km WNW of Cuyujúa, ± 2500 m) (flrs.—Oct. 27, 1971), *J. D. Dwyer 9588* (vicin. Baeza, ± 1900 m) (flrs.—March 27, 1972), *Al. Gentry 12407* (± 2800 m) (flrs.—Nov. 4, 1974).

This *Erythrina* is a tree, up to 8 m, from high elevations (1,900–2,800 m).

I am now trying to obtain its fruits which possibly will help to understand it better. In addition, it is desirable to introduce it to Hawaii for genetic studies. Dr. Russel J. Seibert, formerly at MO, referred to these specimens as "grading into *E. polychaeta*."

T. Plowman 3923 from Napo, canton Quijos, ±2,133 m, is important as it is the first collection seen which "grades" from the common *E. edulis* to this entity.

Rupert Barneby opened two flowers (*Al. Gentry 12407* and *B. MacBryde 561*) and found 8 and 10 ovules.

15b. *Erythrina megistophylla* Diels, Biblioth. Bot. 116: 96. 1937.

Were it not for the Río Palenque Science Center, established in the early seventies in the province of Los Ríos, Ecuador, this species would probably still be concealed in the synonymy of *E. edulis*. Seeds of *E. megistophylla* and its close relatives are soft, large, and quickly spoiled. Up to Oct. 2, 1976, when *C. H. Dodson 6241* was collected, it was not known that the pods are subspherical and 1-seeded. Only recently I finally received sufficient material, including fruits preserved in alcohol, to justify careful studies of this entity. As happened often in the past nine years, Rupert Barneby provided the important proof that it is a distinct species. He opened several flowers (*Dodson 7333*, *Cazalet 5030*, etc.) and found only a single ovule in each. This means, of course, that there is a really fundamental difference in the fruit and that it is not a simple ontogenetic modification of *E. edulis*.

Ecuador: Guayas: Tafalla (?)—*F. H. D. 267*. L. 558 (photo of B sheet lost in world war—holotype), BM (isotype ?), *A. S. Hitchcock 20417** (GH, NY, US) (Teresita, 3 km W of Bucay, 2/0 m) (flrs., infl. with one very immature 1-seeded fruit—July 5–7, 1923),

* Collections marked with asterisk are cited as *E. edulis* in the list of exsiccatae, Suppl. XIII (Krukoff, 1979a).

*F. Fagerlind 657** (S, NY) (NE of Quillallpa, 150 m) (two leaflets, and one detached infl. with flrs.—Oct. 1952), *W. H. Camp E-3643** (NY) (junction of the provinces Guayas, Cañar, Chimborazo, and Bolívar, foothills of the western cordillera near the village of Bucay, 1000–1250 ft) (lvs. and infl.—June 8–15, 1945) (field label reads in part—inflorescences 1–2 at place, on wood of trunk and older branches, arching downward); Los Ríos: *Carlos Játiva 89** (CAS) (along Río Cristal, ± 70 m) (flrs.—July 1962), general region of Río Palenque Science Center, elev. 150–220 m, *C. H. Dodson 4319* (SEL) (flrs.—Aug. 8, 1972), *5334* (SEL, MO) (flrs.—Sept. 16, 1973), *6241** (SEL, MO) (flrs.—Oct. 2, 1976) (frts. said to be subspherical), *6737** (SEL, MO) (mature well-preserved dry fruit—Aug. 11, 1977), *7333* (SEL, NY) (flrs., and 1-seeded fruit, 10 cm long and 7 cm in diam.—Dec. 1, 1978) (infl. seemed to be elongating for more than one year), *7740* (SEL) (seedling 1 m high with fruit still attached), *Al Gentry 9650* (MO) (flrs.—Feb. 5, 1974), *Thomas B. Croat 38658** (MO), *38702** (MO); Chimborazo: Huigra, *J. N. Rose 22594** (NY, GH, US) (lflts., flrs.—Sept. 8, 1918); Pichincha: *P. C. D. Cazalet 5030** (NY, US, K) (20 km W of Santo Domingo de los Colorados, 1000 ft.) (lvs., flrs.—Oct. 16, 1961), *Carlos Játiva 559** (San Miguel near Santo Domingo, 300–400 m), *Elbert L. Little Jr. 6194* (MAD) (between Santo Domingo to Quininda) (flrs.—Apr. 7, 1943); El Oro: 7.3 mi este de Saracay, 1200 ft., zona de transicion entre bosque seco y el de neblina, *Linda Albert de Escobar 860* (lvs., infl. with flrs.—Nov. 23–Dec. 18, 1978) (fruit is said to be with only one seed).

The type collection of E. megistophylla *Diels.*—At the time I was working on my first monograph of the American species of *Erythrina* (Krukoff, 1939), I had on loan three sheets, two from B and one from BM, which were photographed at NY. The first two sheets were lost during World War II. One sheet from B with a very large single detached leaflet was labelled in Diels's handwriting "*Erythrina megistophylla* Diels, Ecuador, Guayaquil, Tafalla" (Tafalla, of course, was an artist who accompanied Ruiz and Pavón); another sheet had two detached inflorescences and a carefully mounted dissected flower on the right (standard, keel, wings, calyx and stamens with pistil). It also was labelled in Diels's handwriting "*Erythrina megistophylla* Diels, Ecuador, Guayaquil 1800 —Tafalla" and in another hand: "Herbarium Peruanum Ruiz et Pavón, *Erythrina ovata* sp. nov., Vulgo "Zapote de perro," F.H.D. 267, L. 538, Año de 1800." The BM sheet had a very large single detached leaflet and a single detached inflorescence. There is no indication that Diels saw this sheet. In a left corner of the sheet was written in Pavón's handwriting (!) "*Erythrina ovata* sp. nov., Hualgayoc del Peru" (Hualgayoc is in Dept. of Cajamarca, Peru, near 79°W, 7°S).

In the original description of this species Diels states: "West-Ecuador: Prov. Guayas: Guayaquil, 1800, vulgo. "Zapote de Perro." (Tafalla?) *F. H. D. 267.* L. 538"—Typus speciei!)."

In my first monograph (Krukoff, 1939) I repeated Diels's statement and wrote: "Tafalla (?) *F. H. D. 267* L. 538" (B, type of *E. megistophylla*, BM)." Diels's specimens naturally were placed by me in synonymy under *E. edulis* Triana as, in addition to Tafalla's specimens, I had seen of this species only *A. C. Hitchcock 20417* (GH, NY, US), which I now recognize as of *E. megistophylla.* The latter was collected in Guayas, Terezita, alt. 270 m on July 2–7, 1923, and has a detached flower with an *immature* 1-seeded pod and very large leaflets.

Although the leaflets and inflorescences on the B and BM sheets are so much alike that they might be from a single branch, we have no irrefutable evidence that they represent a single collection, and, therefore, the BM sheet cannot be considered as an isotype of *E. megistophylla.*

The puzzling question is where Diels obtained information that B sheets

were from Ecuador and not from Peru as written on the same sheets on Ruiz and Pavón's label. Eventually, it may be possible to clarify this by examining Ruiz and Pavón's collections in Madrid, Geneva, Paris, and the British Museum. There are three additional sheets of Pavón's collections in BM and one in P (of the *E. edulis* complex). However, it is merely speculation and in the meantime I have no other choice but to, again, accept Diels's statement in reference to the type locality. Being a careful taxonomist, he must have had reasons for it. I also do not know what F. H. D. and L. stand for. Of course, although we are not certain as to the locality of the type collection, there is no question as to its identity.

Field description.—Nineteen collections of this species are presently available to me, and, as a result, I can make some general statements: it is a rather small spiny tree, usually 3–8 m tall; its flowers (standards) are orange; its inflorescences are invariably cauliflorous, borne on wood of the trunk and older branches, arching downward; its fruits are 1-seeded, subspherical, about 10 × 8 cm when fresh. It occurs at elevations of 70–1,000 m, often in the understory of virgin or secondary forests; it usually is in flower in July or August and has mature fruits from August to October.

Distribution.—Widely distributed in Ecuador and so far collected in the provinces of Guayas, Los Ríos, Chimborazo, Pichincha and El Oro. The remark on the label of *W. H. Camp E-3643* quoted above seems to indicate that it is also found in Cañar and Bolívar.

How it differs from its relatives.—Erythrina megistophylla is related to *E. edulis* and less so to *E. schimpffii* and *E. polychaeta*; the last two species are endemic to Ecuador, whereas the first is found in other sub-Andean countries of South America (see under *E. edulis*).

If fruits are present, *E. megistophylla* is immediately recognized since its fruits are unique: subspherical and 1-seeded (pods and seeds of *E. polychaeta* and *E.* aff. *edulis* are not known, but the leaflets of these two species are either regularly setose-aculeate or at least strikingly reticulate on both surfaces).

Flowers of *E. edulis* cannot be distinguished from those of *E. megistophylla* and of *E.* aff. *edulis* as they all have a broad standard about half as wide as long. The standards of *E. schimpffii* and *E. polychaeta* are narrowly elliptic (over twice longer than wide). Incidentally, during my work on the genus in 1939, flower parts (calyces, standards, keel petals, and wings) were mounted on mica slides permitting their examination without making new disections. These are now at NY (15 slides of collections of *E. edulis* from Ecuador, 11 slides from Colombia, and 8 slides from Peru, also 3 slides of *E. megistophylla*).

Leaflets of *E. megistophylla* can be immediately told from *E. polychaeta* as they are not regularly setose-aculeate on both sides, but cannot be distinguished from races of *E. edulis* with large leaflets which occur at low elevations. However, if a specimen is from an elevation less than 300 m and if it also has terminal leaflets broader than long, with nearly truncate bases and 9–10 secondaries, then chances are good that it is of *E. megistophylla*. Sterile specimens with small leaflets (with acuminate apices) are, of course, immediately recognizable as *E. edulis*.

Erythrina lorenoi F. Macbride was described 7 years earlier than *E. megistophylla* with emphasis on the very large, subrotund, nearly square-based leaflets.

Mature leaflets of *E. edulis*, *E.* aff. *edulis*, and *E. megistophylla* are not ceriferous (mature leaflets of *E. polychaeta* were not seen), whereas those of *E. schimpffii* are reticulate-ceriferous beneath. Unfortunately, very few collections have *mature* leaves since the flowers and leaves are contemporary.

Terminal leaflets of *E. megistophylla* are up to 38 cm long and 44 cm broad, petioles up to 66 cm long, secondaries usually 9–10 per side (versus 8 in *E. edulis*). Dried fruit ±7.5 × 4.5 cm, dark brown, pericarp 1.5 mm thick, seed ±2.5 cm long.

16. *Erythrina speciosa* Andrews, Bot. Repos. 7: *pl. 443*. 1806.

Brazil: Distr. Fed.: Brasilia, *E. P. Heringer s.n.* (13/6-1974) (UB).

This is the first record of this species from the Federal District.

17. *Erythrina polychaeta* Harms, Notizbl. Bot. Gart. Berlin-Dahlem 9: 295. 1925.

At the time I was working on the first monograph of American *Erythrina* (Krukoff, 1939) two collections of this species were available: the holotype (*Rimbach 307*), which was subsequently lost in Berlin and *Rimbach 836* (F, MAD). Both are from Ecuador, from the provinces Chimborazo and Los Ríos (2,500–2,600 m altitude), and both were in flower, in July and September respectively. In Suppl. III (Krukoff 1969: 123) are cited two more specimens: *Acosta Solis 5847* (F), and *6847* (F), from the province of Bolívar (at 1,300 and 2,600–3,000 m alt.). No other specimens have been collected to date.

Pods and seeds of this species are unknown and we do not know whether the inflorescences are cauliflorous.

18. *Erythrina schimpffii* Diels, Biblioth. Bot. 116: 96. 1937.

Ecuador: Azuay: about 3 km from Guayas, ± 1050 m, *J. D. Boeke 2186.*

This species is known from 19 collections, all from Ecuador (provinces of Guayas, Pichincha, Tungurahua, Imbabura, Los Ríos, Cotopaxi, Bolívar, Chimborazo, Cañar, Pastaza, El Oro, Azuay) at elevations of 270 to 1,600 m. Inflorescences are borne on old wood (Camp, Plowman); flowers (standards) are described by several collections as "bright orange" or "crimson orange."

In routine identifications *E. schimpfii* is immediately distinguished from the related *E. polychaeta* as its petioles, petiolules and leaflets are spineless or very sparsely and irregularly aculeate, whereas those of *E. polychaeta* are regularly setose-aculeate (including both faces of the leaflets).

Plowman 5457 through a typographical error was cited as "*3457*" (Suppl. IX, Krukoff, 1977a).

19. *Erythrina montana* Rose & Standley, Contr. U.S. Natl. Herb. 20: 179. 1919.

Mexico: Nyarit: *W. D. Stevens 1474* (MEXU); Durango: steep rock, slopes, *Bennett 808* (MO).

20. *Erythrina leptorhiza* Alph. DeCandolle, Prodr. 2: 413. 1825.

Mexico: Michoacán: cima del Cerro de las Varas, ± 2400 m, *Grupo Etnobiología 192* (5/27-1978).

21. *Erythrina horrida* Alph. DeCandolle, Prodr. 2: 413. 1825.

Mexico: Oaxaca: *Mario Sousa 6052* (MO, MEXU) al pie del Cerro San Filipe, ± 1850 m).

21a. *Erythrina* (Sect. *Leptorrhizae*) *sousae* Krukoff & Barneby, sp. nov.—FIG. 1.

Ab aliis sectionis speciebus calyce longidentato (dente dorsali lineari-lanceolato 9.5–12 mm longo) eximie diversa.

A small shrub, leafy at anthesis; petioles 19–30 cm long, glabrous, occasionally aculeate; petiolules 6–11 mm long soon glabrous; leaf blades chartaceous, glabrous throughout (except veins often puberulent), not aculeate on the costa and veins above and beneath; terminal leaflets broadly ovate-deltoid or suborbicular, 11.5–15.5 cm long, 11–13.5 cm broad, acute at the apex; secondaries ± 6 per side, the veinlets prominent on both surfaces; rachis 21–27 cm long, softly puberulent, soon glabrate, usually aculeate; pedicels ± 8 mm long, puberulent; calyx salmon (ex Sousa) thin-chartaceous, campanulate, ±14–15.5 mm long on the carinal side, ± 19 mm long on the vexillar side, ± 3 mm broad at the base, ampliate to ± 6 mm at the apex, the margin 5-dentate, the dorsal tooth 9.5–12 mm long, the rest shorter; standard erect, red, 55–60 × 9–12 mm; wings linear-elliptic, 9–10 × 1.5–2 mm; keel petals united by the exterior margins, the blade when laid out broadly oblong-obovate, shallowly emarginate, 17 × 8 mm; ovary and gynophore softly pubescent.

Mexico: Oaxaca: district Pochutla, 14 km SSW of San Miguel Suchixtepec, ± 2100 m, *Mario Sousa S. 7563* (June 23, 1977), (NY—holotype, MEXU) *5612* (April 24, 1976) (MEXU) 18 km SW of Suchixtepec, carr. Pochutla—Oaxaca, ± 1700 mm.

The collector describes the plants as *shrubs*, ± 1 m high, rather rare, growing in pine forest.

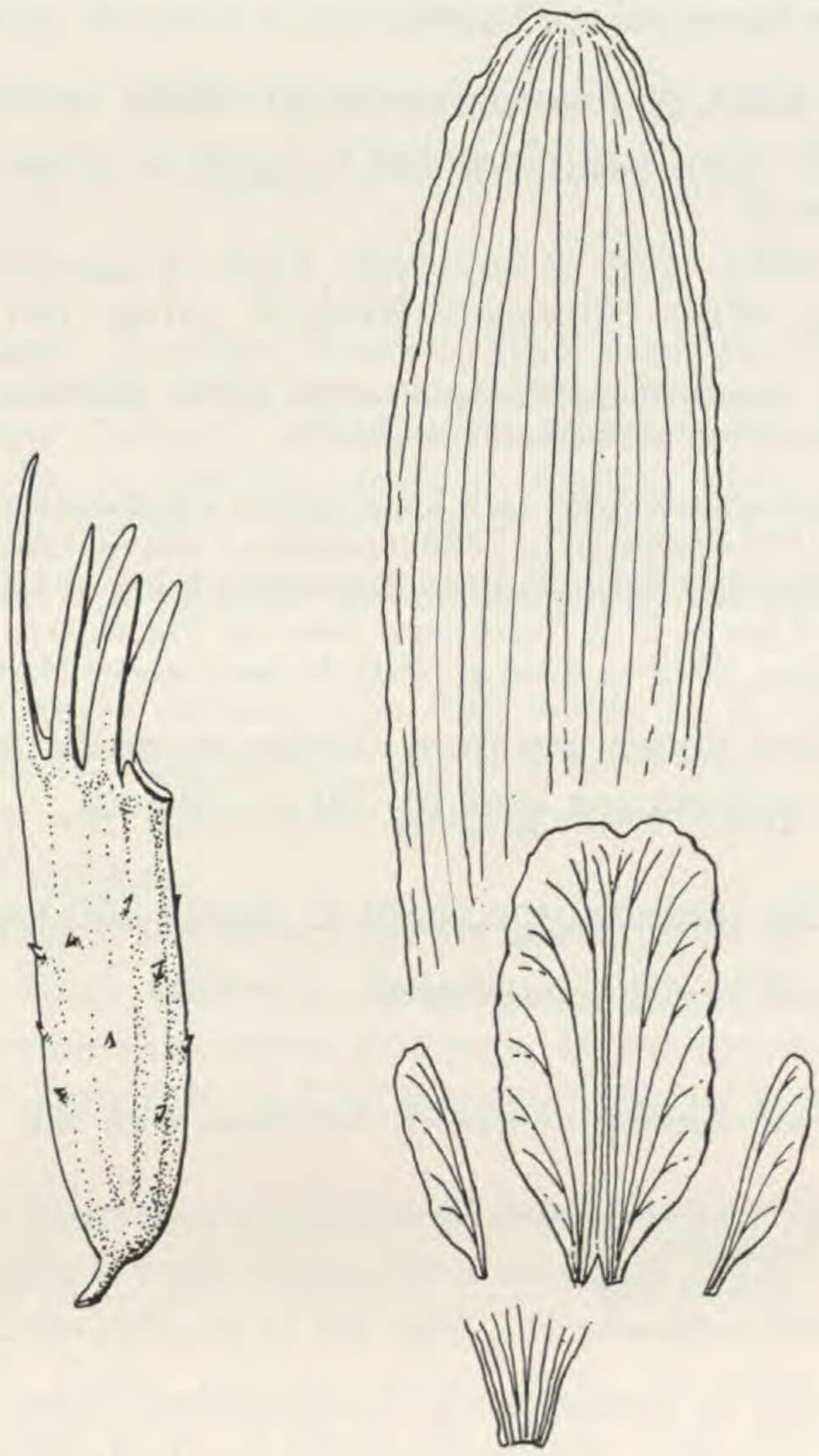
This species is related to *E. horrida* which is however a perennial herb, not a shrub, with the pods and ovary shortly aculeate after anthesis. It is immediately distinguished from *E. horrida* and other members of Sect. *Leptorhizae*, as well as other species of *Erythrina* native to Mexico, by the long teeth on the calyx such as also occur in the unrelated *E. peruviana* of Sect. *Corallodendra*. Its large cuplike stipules recur only in the unrelated *E. poeppigiana* of Sect. *Micropteryx* and in *E. subumbrans* of Sect. *Hypaphorus*. Its keel petals distinguish this species from all known species of *Erythrina*. They are ± 3 times shorter than the standard, broadly oblong-obovate, and shallowly emarginate.

24. *Erythrina flabelliformis* Kearney, Trans. New York Acad. Sci. 14: 32. 1894.

Mexico: Michoacán: *Grupo Etnobiología 111* (Jan. 28, 1978).

25. *Erythrina coralloides* Alph. DeCandolle, Prodr. 2: 413. 1825.

Mexico: Distr. Fed.: Ciudad Univers., ± 2250 m (cult.) *R. Hernández M. 1735*



Erythrina sousae Krukoff

(M. Sousa 7563; x 2)

FIGURE 1. Dissected flower of *Erythrina sousae* Krukoff.

(11/17-1972—flrs.) (MEXU), *1856* (2/2-1973—flrs.) (MEXU), *1919* (4/27-1973—frts.) (MEXU).

26. *Erythrina* aff. *coralloides* Alph. DeCandolle.

Mexico: Querétaro, ± 1900 m, *Elizabeth Arguelles* 388 (flrs.) (MEXU); Michoacán: mun. Tzinzunzan, Ichupio, *Grupo Etnobiología 121* (1/28-1978).

27. *Erythrina pudica* Krukoff & Barneby, Phytologia 27: 114. 1973.

Additional collections of this species, which is known only from three collections in the state of Chiapas, Mexico, are desirable. Pods and seeds are not known.

28a. *Erythrina lanata* Rose subsp. *lanata*.

Erythrina lanata Rose, U.S.D.A. N. Amer. Fauna 14: 81. 1899.

Mexico: Michoacán: *Mario Sousa 8014* (El Cangrejo, a 16 km al NE de la Huacana, ± 1050 m), *H. Hernández 5*.

28c. *Erythrina lanata* subsp. *calvescens* Krukoff, subsp. nov.

A subsp. *occidentali*, remote allopatrica, praesertim calyce glabrato, a subsp. *lanata* insuper vexillo parce hirtello (nec dense albo-lanato) absimilis.

Mexico: Oaxaca: *Mario Sousa 5506* (a 6 km al SE de Cacahuatepec), *7056* (a 2 km al SE de Pinotepa Nacional) (NY—holotype), *7452* (camino a playa Chipehua, a 37 km al SW de Salina Cruz, distr. Tehuantepec), *7493* (Los Tunillos, a 2 km al ENE de la Reforma, distr. de Yautepec), *7541* (a 13 km al E de Tutolapan, distr. de Tlacoluia), *7586* (a 14 km al E de Pochutla, distr. de Pochutla), *7642* (a 4 km al NNE de San Gabriel Mixtepec, distr. de Juquila).

The collections cited above are from shrubs or small trees 2–5(–6) m high found at low elevations, from sea level to 700 (1,150) m.

Below is a key to the three subspecies of *E. lanata* and two related species.

1. Standard glabrous, even in very young flowers.
   2. Calyx glabrous ..... *E. goldmanii*
   2a. Calyx lanate ..... *E. pudica*
1a. Standard densely lanate dorsally or sparsely hirtellous with fine hair, especially on young flowers.
   3. Standard densely lanate ..... *E. lanata* subsp. *lanata*
   3a. Standard thinly hirtellous.
      4. Calyx white tomentellous ..... *E. lanata* subsp. *occidentalis*
      4a. Calyx essentially glabrous ..... *E. lanata* subsp. *calvescens*

The new subspecies is immediately distinguished from the two other subspecies by the glabrous calyx. Leaflets and fruits (including a very conspicuous and broad black line near the hilum) are essentially like those in the two other subspecies.

Unfortunately, I have not seen the new subspecies in the field. As is the case with the two other subspecies of *E. lanata* and *E. pudica*, its standards are pink, but I do not yet know the color of its calyces, which are strikingly black in *E. goldmanii*. I also do not know whether the flowers and buds before anthesis are deflected from the floral rachis, the standard eventually forming an angle of about 45° from the vertical (as is the case with *E. pudica*).

In routine identification fruiting specimens of *E. lanata* subsp. *calvescens* were often confused in the past with *E. herbacea* subsp. *nigrorosea*. If mature seeds are available, they are immediately told apart as seeds of the former have a very distinct, broad, black line near the hilum, whereas in seeds of the latter, this line is not distinct.

In Suppl. VII (Krukoff & Barneby, 1973: 114–117) Barneby and I described the related *E. pudica* and reviewed at length the two subspecies of *E. lanata* (subsp. *lanata* and subsp. *occidentalis*). Besides differing in morphological characters of the flowers, they were found to have different distributional ranges. All presently examined collections from Oaxaca cannot be accommodated in the two previously known subspecies, as is evident from the key.

32. *Erythrina tuxtlana* Krukoff & Barneby, Phytologia 25: 11. 1972.

Additional collections of this species, known only from two collections from the type locality in mun. Tuxtepec, Oaxaca, Mexico, are desirable.

41. *Erythrina chiriquensis* Krukoff, Brittonia 3: 322. 1939.

Nicaragua: Matagalpa: Cordillera Dariense, Santa Maria de Ostuma, ± 1500 m, lower montane wet forest, *David Neill 2974* (MO). Costa Rica: Cartago: *Krukoff 1973-4* (Birrisito de Paraíso), *1973-5* (near Cartago), *1973-6* (Tres Ríos); *F. Almeda 4174* (CAS) (south slope of volcano Turrialba, ± 4400 ft); Alajuela: *Krukoff 1973-7* (near Zarcero), *1973-8, 1973-9, 1973-10.* Panama: Chiriquí: Cerro Punta, ± 6000 ft, *J. P. Folsom 3999* (MO).

Folsom's specimen is a voucher for seeds which are under chemical studies by Prof. Jackson.

Few, if any, erythrinas caused such difficulties as *E. chiriquensis*, and even now it is not completely understood. We still need good fruiting material from Nicaragua for which we have been waiting since 1973, also collectors' field observations of *fresh calyces.*

Erythrina chiriquensis was described by me in 1939 on the basis of a single collection in flower from Chiriquí, Panama (1,300–1,900 m). Now we have ample material (20 collections) from Panama. Dried specimens of it are remarkably uniform in all characters and have never caused any difficulties in identification.

Difficulties were, however, encountered when Rupert Barneby and I started to work on my collections from Costa Rica made in 1969. *Erythrina globocalyx* is found in Costa Rica which, as is the case with *E. guatemalensis* and *E. steyermarkii*, has ellipsoid, fleshy calyces, when fresh broadest in the middle and contracted at the mouth so as to clasp the petals and stamens. [See Barneby's drawings of calyces of fresh flowers of *E. globocalyx* and *E. steyermarkii* in Krukoff (1970: 20)]. This character, which is so striking in fresh flowers, cannot be observed in dried specimens, and we tried to tie this in with the thickness of the calyx. *Erythrina chiriquensis*, as represented from Chiriquí, has a definitely thickened calyx, not so thick, however, as *E. globocalyx* from the type locality (village of Los Nubes, San José, Costa Rica), but almost as thick as specimens from Zarcero, Alajuela, Costa Rica. As specimens from Costa Rica (from Los Nubes as well as from Zarcero) were collected by me, I was not prepared to accept Zarcero specimens under *E. globocalyx* as the plants are immediately told apart in fresh condition. They were cited under *E. chiriquensis* in Suppl. III, IV, and V (Krukoff, 1969, 1970, 1971).

In Feb. 1973 I made a special trip to Alajuela and Cartago in Costa Rica, collecting numerous specimens, and we came to the same conclusion. It is unfortunate that I never saw *E. chiriquensis* from the type locality in the field.

Several collections from the Cordillera Central de Nicaragua (1,200–1,500 m) in Dept. Matagalpa were placed under *E. chiriquensis* in Suppl. VIII (Krukoff 1976: 348), and again it is most unfortunate that I did not see any plants of this entity in the field.

Recently Rupert Barneby and I went over the entire problem again. Flowers (including keel petals and wings) and leaves in specimens from Chiriquí, and

Nicaragua are essentially alike, and we have to wait for collectors' observations of calyces of fresh flowers of plants from Chiriquí and Nicaragua and seeds from Nicaragua before reviewing this problem again.

Erythrina chiriquensis from Chiriquí has already been introduced to two gardens in Hawaii, and we must also introduce plants from Costa Rica and Nicaragua. The final word in this problem will probably come from genetic studies when we will be growing these plants in Hawaii side by side.

42. *Erythrina macrophylla* Alph. DeCandolle, Prodr. 2: 411. 1825.—FIG. 2.

El Salvador: Chalatenango: El Pital, *E. A. Montalvo 4821*. Guatemala: Jalapa: Pinula–Jalapa, *Oswaldo Téllez 602* (4/9-1978—flrs.); Chimaltenango, 8 km E of El Tejar, between El Tejar and Sumpange, or 12 km NW from Antigua, near the road from Guatemala to Chimaltenango, *Mario Sousa S. 4224* (Sept. 7, 1978—flrs.), *Krukoff 1978/21* Dec. 1978—flrs., frts.).

The above are new records for the departments of Chalatenango and Jalapa, in Guatemala and El Salvador, respectively. Specimens collected by Mario Sousa and later in the same locality by Krukoff need to be discussed. Sousa's collection is normal for the species in all respects except that the calyx is provided with five teeth 2–3 mm long (see Fig. 2). A special trip was made by me to the locality where this collection was obtained, and I ascertained that this unusual collection cannot be distinguished even as a form for, although the teeth on some of the specimens are long, there are many others which approach the more common form with smaller teeth. Incidentally, the fruits of these collections, as those of typical *E. macrophylla*, can be easily distinguished at a distance, as pods are only slightly constricted between the seeds and hang down in a very characteristic manner. Standards, keel petals, and wings, as well as leaves, are indistinguishable from the common form of the species. Furthermore, a rather thorough search in this locality resulted only in finding all gradations from Sousa's collection to a more common form. Krukoff's collection (in flrs. & in frts.), carefully chosen, represents an intermediate form with calyx teeth about 1 mm long.

45. *Erythrina steyermarkii* Krukoff & Barneby, Mem. New York Bot. Gard. 20: 175. 1970.

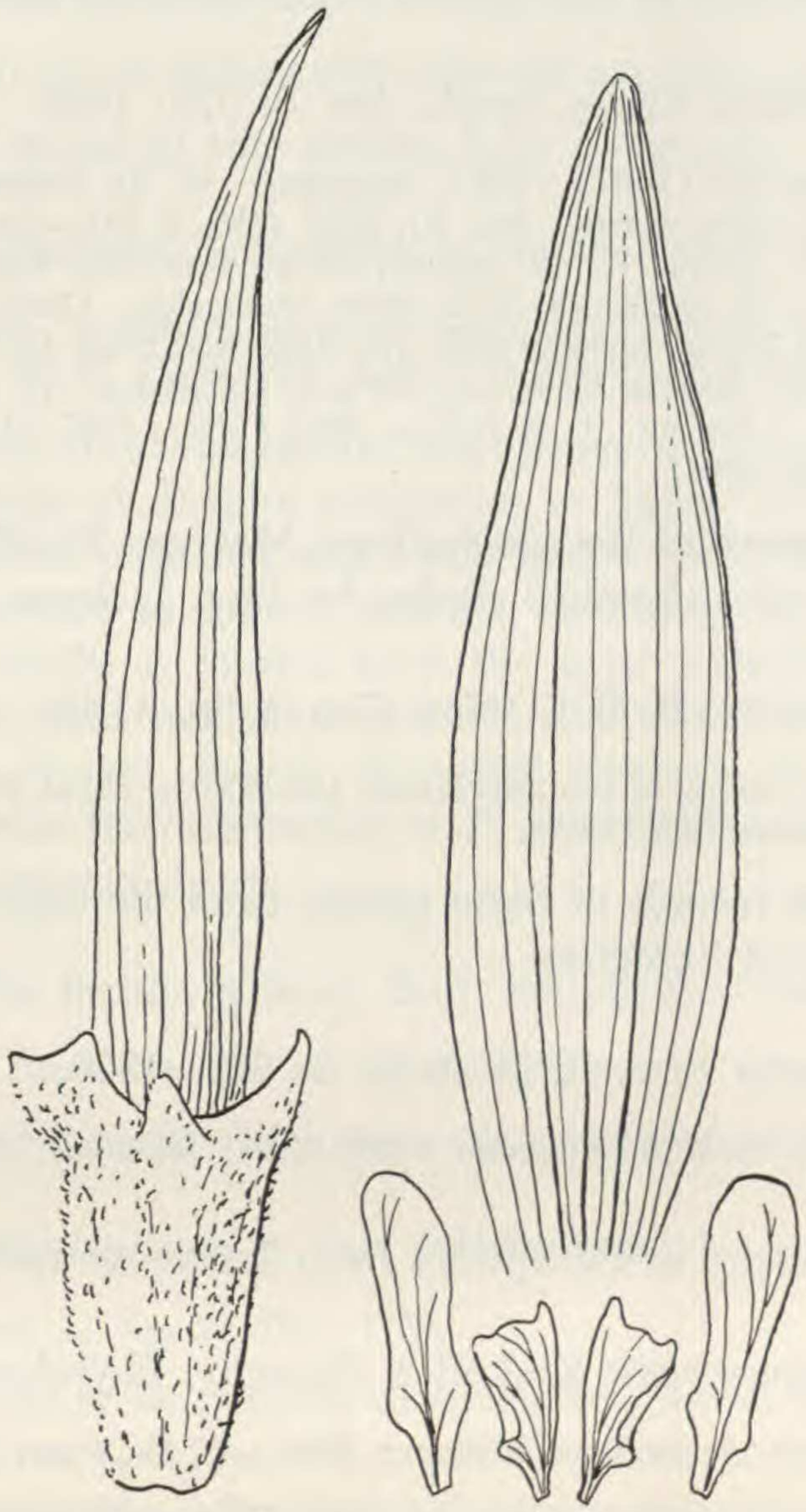
Nicaragua: Chontales: ± 400–500 m, *W. D. Stevens 6124*; Matagalpa: ± 370 m, *W. D. Stevens 6023*; Zelaya: *David Neill 3719* (along Caño Madriguera, ± 250 m), *4142* (Kuikuinita, ± 160 m), *W. D. Stevens 6823* (MO) ± 600–800 m, *6893* (along Caño Majagua), *7375* (Cerro Waylawas, 100–268 m), *8819* (Siuna to Matagalpa), *Paul C. Vincelli 330A, 407* (along Caño el Toro).

This is the first record of this species from Matagalpa.

47. *Erythrina berenices* Krukoff & Barneby, Phytologia 27: 120. 1973.

Mexico: Veracruz: *A. Gómez-Pompa 1837* (Dec. 9, 1966) ± 1000 m), *Wilfrido Márquez M-851* (F) (Tlalnalhuayacan, ± 1400 m), *Vicente Vasquez Torres W279* (F) Zongolica, ± 1150 m).

This species was known previously from four collections, all from high elevations in the state of Veracruz and cited with the original description.



(M. Sousa 4224; x 2)

FIGURE 2. Dissected flower of *Erythrina macrophylla* Alph. De Candolle.

49. *Erythrina lanceolata* Standley, Contr. U.S. Natl. Herb. 17: 432. 1914.

Nicaragua: Matagalpa: Sta. Maria de Ostuma, ± 1300 m, *Antonio Molina 31623* (MO). Panama: Chiriquí, 2½ km from Questa Piedra along Río Monte road, *J. P. Folsom 3986* (MO).

This is the first record of the species from the province of Chiriquí.

50. *Erythrina costaricensis* M. Micheli, Bull. Herb. Boissier 2: 445. 1894.

Panama: Coclé: *J. P. Folsom 5637* (MO), *6435* (MO), *Barry Hammel 3848* (MO); Colón: *G. A. Sullivan 139* (MO).

This is the first record of the species from the province of Coclé.

52. *Erythrina americana* Miller, Gard. Dict., ed. 8, no. 5. 1768.

Mexico: San Luis Potosí: Tamanzunchale, *Mary Taylor Edwards 682* (MO).

This is the first record of the species from San Luis Potosí.

53. *Erythrina berteroana* Urban, Symb. Ant. 5: 370. 1908.

Nicaragua: *Seemann 26* (1867) (BM); Managua: *W. D. Stevens 4543* (800–860 m), *5136, 5817* (800–900 m) (flrs. & frts.—Jan. 6), *6191* (flrs. & frts.—Jan. 28); Masaya: *David Neill 2811* (MO), *3120* (MO), *W. D. Stevens 5258*; Granada: foot of Volcán Momacho, *David Neill 2726*; Estelí: *W. D. Stevens 5772, 9088*; Matagalpa: *David Neill 848* (Matagalpa–Jinotega, 1100–1300 m), *W. D. Stevens 6007* (± 1100 m), *6024* (± 335 m); Boaco: *J. D. Atwood 3834* (F), *W. D. Stevens 5830* (± 275 m); Chontales: *W. D. Stevens 3664, 4177* (350–400 m). Panama: Chiriquí: *J. P. Folsom 3936* (MO), *3957* (MO); Canal Zone: *J. P. Folsom 3661, 3662, 3663, 3664.*

This is the first record of the species from Masaya. Six Folsom specimens are vouchers for seeds under chemical studies by Prof. Jackson.

54. *Erythrina rubrinervia* H. B. K., Nov. Gen. & Sp. 6: 434. 1824.

Panama: Veraguas: valley of Río Dos Bocas, 450–550 m, *Croat 27763* (MO). Colombia: Antioquia: *John D. Sheperd 665* (MO).

These are the first records of these species from the department of Antioquia and from the province of Veraguas.

55. *Erythrina mexicana* Krukoff, Brittonia 3: 309. 1939.

Mexico: Zacatecas: *Kalil S. Boghdan 39356* (A); Hidalgo: mun. Ilanchinol, *Emma Estrada Martínez 192.*

This is the first record of the species from Zacatecas and Hidalgo.

56a. *Erythrina santamartensis* Krukoff & Barneby, Phytologia 33: 350. 1976.

Colombia: Sierra Nevada de Santa Marta, ± 200 m, *E. W. Davis 561.*

This is the third collection of this species. The collector states on the label: "seeds red and black." This statement is intriguing but search in the Harvard herbaria, including the fruit collections, failed to locate pods or seeds of this collection.

57. *Erythrina castillejiflora* Krukoff & Barneby, Mem. New York Bot. Gard. 20: 165. 1970.

The tree from which the type material was collected was cut down, and repeated attempts to find another one failed. Incidentally, this is one of the three species of which young leaves and flowers are consumed in soups and salads; the others are *E. berteroana* and *E. americana.* At times I have doubts that it is a distinct species. Perhaps it is a hybrid of *E. berteroana,* but there is not a single other species of *Erythrina* in the type locality which could be considered as another parent. As it was collected in a disturbed forest area, perhaps it was introduced from the completely uncollected, vast, lowland virgin forest on the Río Ixcán, a tributory of the Río Usumacinta in the departments of Huehuetenango and Quiché in Guatemala.

58. *Erythrina gibbosa* Cufodontis, Arch. Bot. Sist. 10: 34. 1934.

Nicaragua: Zelaya: *W. D. Stevens 4797* (200–300 m), *5066* (Caño Costa Riquita).

This is the first record of this species from Nicaragua.

59. *Erythrina amazonica* Krukoff, Brittonia 3: 270. 1939.

Peru: Junín: Satipo, ± 350 m, semi-arid cactus-acacia forest, *M. T. Madison 10453-70* (F). Ecuador: Napo: *E. W. Davis 424* (AAU) (± 750 m, used commonly for fence posts).

This is the first record of the species from Junín. It is a poorly known species, which perhaps consists of distinct subspecies or forms. I have seen collections with all red and others with red and black seeds. The study of this species is difficult as it is confined to special habitats, in widely separated regions. The closely related *E. similis* is known from the type collection (region of Lake Ypacaray, Paraguay) and two poor and old collections, one from Bolivia and another from Mato Grosso, Brazil. Repeated attempts failed to produce new collection of this. Once the distribution of *E. amazonica* is well known, *E. similis* might become a subspecies of it.

63. *Erythrina pallida* Britton & Rose, Bull. Torrey Bot. Club 48: 332. 1922.

Trinidad: Simla: *Peter Feisinger s.n.* (Febr. 1978).

This is a voucher for seeds which are under chemical studies by Prof. Jackson.

64a. *Erythrina corallodendrum* L. var. *corallodendrum*

Erythrina corallodendrum L., Sp. Pl. 706. 1753.

It will probably never be possible to completely know the original ranges of distribution of the three varieties of *E. corallodendrum* as they are almost extinct in the wild but extensively cultivated and/or escaped from cultivation.

67. *Erythrina leptopoda* Urban & Ekman, Ark. Bot. 20A(5): 14. 1926.

Dominican Republic: Manigua: cerca de Ciénaga de Monabáo, Jarabacoa, ± 900 m, *A. Liogier 24366.*

This is the first record of this species from the Dominican Republic. It was known previously from eight collections from Haiti, all collected by H. Ekman and all cited in Krukoff (1939: 305–307).

68. *Erythrina elenae* Howard & Briggs, J. Arnold Arbor. 34: 183. 1953.

Erythrina linearifoliata Areces, Ciencias, Ser. 10, Bot. (Univ. Habana) 3: 11. 1975.

In the original description of *E. linearifoliata* it is stated that an isotype was sent to JE. On April 20, 1977, I received a communication from this herbarium to the effect that, up to that date, this specimen had not been received at Herbarium Haussknecht, Jena.

70. *Erythrina oliviae* Krukoff, Phytologia 19: 128. 1969.

Mexico: Puebla: El Papayo, *Mario Sousa 7197* (flrs.—Apr. 12, 1977, leafless), *H. Hernández s.n.* (Apr. 15, 1978) (MEXU), *1* (Chinantla) (MEXU); Michoacán: *M. T. Germán 409* (km 227 de la carretera Arteaga—Infiernillo) (May 21, 1977—flrs.) (MEXU), *H. Hernández 2* (May 23, 1978) (sobre la carretera que va del entroque de Ruta Nueva Italia-Arteaga a la presa del Infiernillo).

This is the first collection of this species outside of the type locality in the Oaxaca Desert, and it is a new record from the state of Michoacán. Mario Sousa reports that they made a special trip to the type locality of *Erythrina oliviae* to collect a specimen of it, and then they found it in the state of Michoacán.

72. *Erythrina lysistemon* Hutchinson, Bull. Misc. Inform. 1933: 422. 1933.

Rhodesia: Salisbury, cult., *T. Müller 2703* and *2704*.

These are vouchers for seeds which are under chemical studies by Prof. Jackson.

76. *Erythrina greenwayi* Verdcourt, Kew Bull. 25: 175. 1971.

Tanganyika: Iringa District, *P. J. Greenway & Kanuri 14814* (BM).

78. *Erythrina vogelii* Hooker f., Niger Flora 307. 1849.

Upper Volta: *C. Geerling 1086* (MO) (Sindou, savanna), *1215* (MO) (Bobo–Dioulasso, in creek ravine), *1631* (MO) (3 km E of Bouna).

These are the first three collections of this species seen by me from Upper Volta.

79. *Erythrina senegalensis* Alph. DeCandolle, Prodr. 2: 413. 1825.

Sierra Leone: *coll. undesign. s.n.* (Herb. Lamb.) (BM) (holotype of *E. guineensis* G. Don).

82. *Erythrina pygmaea* Torre, Bol. Soc. Brot., sér. 2, 39: 213. 1965.

I hope to see additional material of this species known from a single poor specimen in fruit. It was collected in Angola.

83. *Erythrina mendesii* Torre, Bol. Soc. Brot., sér. 2, 39: 212. 1965.

Botswana: *P. A. Smith 1872* (K) (26/12-1976—flrs.).

This is the first record of this species from Botswana.

88. *Erythrina addisoniae* Hutchinson & Dalziel, Bull. Misc. Inform. 1929: 17. 1929.

Ghana: Kumasi: *A. A. Enti FE-1821*.

This is a voucher for seeds which are under chemical studies by Prof. Jackson.

92. *Erythrina haerdii* Verdcourt, Kew Bull. 24: 285. 1970.

Additional material of this species, native to Tanzania, is needed. Pods and seeds are not yet known.

93. *Erythrina sigmoides* Hua, Bull. Mus. Hist. Nat. (Paris) 3: 327. 1897.

Senegal: Niokolo-Koba N. P., *C. E. G. Tutin 43* (K).

This is the first collection of the species seen by me from Senegal.

95. *Erythrina abyssinica* Lamarck, Encycl. Bot. 2: 392. 1788; ex Alph. DeCandolle, Prodr. 2: 413. 1825; Gillett, Kew Bull. 15: 426. 1962.

Kenya: Kilima Kiu, Machakos District, *Prescott Decie s.n.* (1914) (syntype of *E. platyphylla* Baker f.). Angola: highlands of Golongo Alto, *Welwitsch 2229* (BM) and *2230* (BM) (syntypes of *E. suberifera* Welwitsch); Huilla: 3800–5500 ft, *Welwitsch 2231* (BM) (holotype of *E. huillensis* Welwitsch). Rhodesia: Salisbury: *T. Müller 2705*.

Müller's specimen is a voucher for seeds which are under chemical studies by Prof. Jackson.

96. *Erythrina variegata* L., Herb. Amboin. 10. 1754; Amoen. Acad. 4: 122. 1759, based on *Gelala alba* Rumphius, Herb. Amboin. 2: 234, *tab*. 77. 1750.

Australia: Queensland: *M. Lawrie s.n.* (Sept. 1971) (Dawan Island), *Everist 9696* (Goold Island), *D. R. Stoddart 4247* (Green Island), *7266* (South Island), *C. T. White 10123* (Hayman Island), *M. Lawrie 100, 105* (Murpay Island), *L. S. Smith 4857* (Bingil Bay), *L. J. Webb 3021* (Mission Bay), *J. G. Tracey 3353, V. K. Moriarty 1574* (Clump Point, edge of rain forest on beach), *S. A. Renvoize 1335* (US).

In Suppl. X (Krukoff, 1977b: 409) I stated: "The above eight specimens are irrefutable evidence that this species is native to Northern Australia and not introduced for cultivation." The 12 specimens cited above not only confirm this statement but also indicate clearly that this species in northern Australia is common on the Islands and on the shore of the ocean in Northern Territory and Queensland.

97. *Erythrina tahitensis* Nadeau, Enum. Pl. Tahiti 80. 1873.

Hawaii: *Glen Spence s.n.* (July 17, 1978).

I have been waiting for many years to grow plants of this species from Hawaii and Tahiti side by side. We will have this opportunity before long. Recently this species has been found in Tahiti and plants are being grown in Hawaii in the Pacific Tropical Botanic Garden as well as in the Waimea Arboretum.

As predicted (Krukoff, 1972: 137), this species is not extinct in Tahiti and is found on very steep slopes. It was found by S. Perlman with help of guide Henri Jay on the western side of Tahiti, at Mapura (±2,000 ft). Mr. Jay stated that he knows four other trees from the Popenoe valley, on the eastern side of Tahiti.

98. *Erythrina euodiphylla* Hasskarl, Hort. Bogor. 178. 1858.

East Java: *C. Backer s.n.* (Oct. 1907—flrs.) (Tandjonj Prook, cult., "flrs. green") (BO) this is the note which gave the wrong information that the flowers in this species are green, which error was repeated by several subsequent workers), *Herb. Bogor 2-0-10* (seeds) (cult.) (BO) (some seeds may not belong here, they resemble those of *E. variegata*), *2-0-16* (flrs.) (cult.) (BO), *Herb. Hort. Bogor 4701* (flrs., frts.) (BO), (these are the pods and seeds from which Rupert Barneby made a drawing published in Lloydia 37: 434. 1974), *Herb. Bogor 837*

(11/8-1922—flrs.) (Soerabaja) (BO), *879* (29/8-1922) (Soerabaja) (BO), *D. T. H. 3870* (Soerabaja) (BO), *R. van der Veen s.n.* (Febr. 1979) (seeds only collected at Baluran Nature Reserve) (MO, NY) (seeds closely resemble those of *E. variegata*; they are now planted in two Botanical Gardens in Hawaii and in 2–3 years, at which time the plants will be in flower, their identity will be known.

After a search of all *major* herbaria in the Orient, Europe, and the United States, I ascertained that this species is represented only by two collections in Leiden and by several specimens in Bogor. This does not mean that it is rare or an "endangered species." It is merely found in a seldomly collected region ("savanna of man-size grasses and scattered trees"). Its best field description is found on *M. Jacobs 4886* (24/5-1951) collected at Besuki, S foot of Mt. Baluran Game Preserve, 1–6 km N of Wonokedje, 114° 20′ E, 7° 50′ S. The collector states that it is a "tree 8–10 m with rough bark, leafless, flrs. odorless, *standard fulvous-ochreous*, other petals glossy green-brown, filaments red, paler toward base, anthers dark brownish or white floccose, style red, stigma green. Common."

This information was confirmed by van der Veen in July 1975 when he obtained specimens in flower and made slides.

99. *Erythrina vespertilio* Bentham in Mitch., J. Trop. Austr. 218. 1848.

Erythrina biloba F. v. Müell. in Hooker's J. Bot. Kew Gard. Misc. 9: 21. 1857.

Dr. J. R. Maconochie supplied us with useful information on the two type collections:

The type collection of *Erythrina vespertilio* Benth. Label Data:

1846 No. 189, June 29/46
Thorny shrub. sub-Trop. New Holland
Lieut.-Co. Sir T. L. Mitchell

From Mitchell's Journal, they spent that day (29) travelling along the left bank of a newly found river. On the 30th June Mitchell recorded collecting a new *Erythrina*—a thorny shrub and from his map its approximate locality is 25° S and 147° 30′ E.—The Warrego District of Queensland.

The type collection of *Erythrina biloba* F. v. Müeller

F. Müell's label at K: "This was nowhere seen but on the foot of a little Granite Range at the head of Hooker's Creek and Sturt's Creek. It bore neither flowers nor fruits but I found two or three grains of seeds and a few half damaged valves. We intended to revisit the spot on our return but took a straight course across the country (viv. map) and thus I could not procure more specimens."

This location was reached about 15 January, 1856 and the head of these two creeks is approximately 18° lat., 130°E long.—in Northern Territory.

Dr. P. R. Wycherley kindly supplied me with very interesting information on the occurrence of this species and on the flowering and fruiting seasons in Western Australia:

The nearest *Erythrina vespertilio* is nearly 900 miles from Perth and it occurs sporadically in small groups of trees near river beds along a further 1200 miles to the north western extremity of Western Australia, about 2000 miles from Perth by road, most of the latter part being on unsealed roads. Four-wheel drive vehicles are essential for any field work. One can sometimes save time by flying and hiring local transport, but usually at greater cost. Recent survey work in the north west has used helicopters.

Although the flowering and fruiting seasons can be predicted in general terms, in practice

much depends on the vagaries of each year. The northwest is a mainly summer rainfall area by contrast with winter rains in the south west. Too soon and the seed is unripe. Even a day or two late and the dehiscent pods have thrown out their seeds.

Dr. L. Pedley of the Queensland Herbarium recently sent me two photographs of *E. vespertilio* (typical form) with white flowers (standards). This is the first record of such flowers in this species. I already reported earlier in this paper of the occurrence of white flowers in *E. verna* and *E. herbacea* subsp. *herbacea*. Such flowers are seen occasionally in several other species, and it is desirable to incorporate some of the white-flowered plants in our genetic studies in Hawaii. I am now trying to obtain seeds of *E. vespertilio* with white flowers.

101. *Erythrina merrilliana* Krukoff, J. Arnold Arbor. 20: 227. 1939.

New Guinea: Madang District: rain forest, ± 40 m, *P. Katik 46673*.

This is the first record of the species from Madang District. It was known previously from Central, Morobe, and Milne Bay District.

102. *Erythrina velutina* Willdenow, Ges. Naturf. Freunde Berlin Neue Schriften 3: 426. 1801.

Brazil: Rio Grande do Norte: *A. Castellanos 22820* (R); Sergipe: Japaratuba, *Herb. Jard. Bot. Rio 175067*.

These are the first records of the species from Rio Grande do Norte and Sergipe.

102a. *Erythrina velutina* Willdenow f. *aurantiaca* (Ridley) Krukoff, Brittonia 3: 329. 1939.

Paraiba: estradu entre São João da Cariri and Serra Branca; *J. Mattos 9768* (SP), *s.n.* (21/2-1962) (SP).

It is very satisfactory that *E. aurantiaca* Ridley was reduced to a form as we now have more evidence that it is neither a species or subspecies. Dr. Dardano A. Lima told me that during his visit to the Island of Fernando Noronha (the type locality of *E. aurantiaca* Ridley) he observed that the majority of the trees there have red seeds and only a few have red and black seeds. Trees with seeds red and black were found recently in Ceará and Paraíba.

In numerous collections of *E. pallida* seeds are invariably scarlet with ¼ or ⅕ of the seeds black, so this character is consistent. The same might be said concerning *E. perrieri*, although there are not too many collections known of this species. On the other hand, there are races of *E. amazonica* which have seeds scarlet and black in about ⅕ of the seeds. Seeds of this species, as it is presently understood, are usually red.

We now have plants of *E. velutina* f. *aurantiaca* grown from red and black seeds (collected in Brazil) in Hawaii, side by side with plants grown from red seeds.

Matto's specimens from Paraíba have seeds red and black in about ⅕ of the seeds.

103. *Erythrina grisebachii* Urban, Symb. Ant. 9: 453. 1928.

E. grisebachii was retained in the first monograph (Krukoff, 1939) as a good species largely because of the size of its flower. I stated: "I retain Urban's species for the time being, but field studies may prove that it is better regarded as a variety or an ecological form of *E. velutina*." The following facts should be taken into consideration in making a decision on this name:

1. Specimens of *E. grisebachii* are from trees grown on *rich* soils of Cuba, mostly from street trees, etc. If they are compared with specimens taken from trees grown on poor soils in desertlike countries (to which *E. velutina* is largely confined), these flowers are at least two times larger.
2. Typical *E. velutina* occurs in Cuba.
3. We now have specimens, such as *Epling 496* from Ecuador, with very large flowers.
4. *Box 1410* from Antigua has flowers indistinguishable from *E. grisebachii* which is supposed to be endemic of Cuba. The collector notes on the label, "There are probably less than half a dozen of these trees in the Island growing apparently wild in the higher parts of the central region."
5. *Luiz Emygdio 2133* from Rio de Janeiro also has large flowers.

The problem with *E. grisebachii* could be solved satisfactorily only by horticultural testing. The difficulty is that up to the present we were unable to obtain seeds of *E. grisebachii* from Cuba for growing in Hawaii.

It is interesting that a more or less similar situation exists with the extremely variable and widespread *E. variegata*. Some specimens from New Caledonia deposited at P have the smallest flowers for this species, at least three times smaller than those of specimens of some races in India or elsewhere. Of course, I do not know in what ecological conditions this species is growing in New Caledonia.

105. *Erythrina burana* R. Chiovenda, Atti Reale Accad. Italia, Mem. Cl. Sci. Fis. 11: 27. 1940.

Ethiopia: Addis Ababa: (cult.), *Mesfin Tadesse s.n.* (July 18, 1978).

This is a voucher for seeds which are under chemical studies by Prof. Jackson.

107. *Erythrina schliebeni* Harms ex Mildbraed, Notizbl. Bot. Gart. Berlin-Dahlem 12: 512. 1935.

Additional collections, especially of fruits and seeds, which not yet are known, are needed to compare with those of *E. perrieri*. Flowers and especially calyces of these two species are suspiciously similar.

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